

I claim:

1. An optical pickup apparatus comprising:

an electronically reconfigurable diffraction grating modulating relative light intensities of at least two different diffraction orders of light diffracted by said electronically reconfigurable diffraction grating;

delivery and focusing optics for focusing said light diffracted by said electronically reconfigurable diffraction grating into diffractive spots corresponding with each of said diffraction orders and delivering said directed light onto an optical storage medium, which light is then reflected by said optical storage medium; and

a detector for detecting said light reflected by said optical storage medium and striking said detector.

2. The apparatus of claim 1, wherein:

said diffraction orders comprise two diffraction orders comprising zeroth and first diffraction orders;

said delivery and focusing optics causes said diffractive spots corresponding with said zeroth order to partially overlap with said diffractive spots corresponding with said first order; and

overlapping light from said zeroth and first diffractive orders striking said detector is resolved into its proper orders by examining the modulation of the intensities of said overlapping light in relation to known modulation frequencies of said zeroth and first diffraction

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13 orders by said electronically reconfigurable diffraction
14 grating.

1 3. The apparatus of claim 1, wherein:

2 said diffraction orders comprise more than two
3 diffraction orders, comprising zeroth and first diffraction
4 orders, and at least one additional diffraction order higher
5 than said zeroth and first diffraction orders.

1 4. The apparatus of claim 1, wherein:

2 said diffraction orders comprise more than two
3 diffraction orders, comprising zeroth and first diffraction
4 orders, and at least one additional diffraction order higher
5 than said zeroth and first diffraction orders;

6 said delivery and focusing optics causes said
7 diffractive spots corresponding with each said diffraction
8 order to partially overlap with said diffractive spots
9 corresponding with at least a diffraction order adjacent
10 thereto; and

11 overlapping light from said more than two diffractive
12 orders striking said detector is resolved into its proper
13 orders by examining the modulation of intensities of said
14 overlapping light in relation to known modulation
15 frequencies of said more than two diffractive orders by said
16 electronically reconfigurable diffraction grating.

1 5. The apparatus of claim 1, wherein:

2 said diffraction orders comprise more than two
3 diffraction orders, comprising zeroth and first diffraction

orders, and at least one additional diffraction order higher than said zeroth and first diffraction orders;

said delivery and focusing optics causes said diffractive spots corresponding with each said diffraction order to partially overlap with said diffractive spots corresponding with at least a diffraction order adjacent thereto; and

overlapping light from said more than two diffractive orders striking said detector is resolved into its proper orders by examining the modulation of intensities and the phase shift of said overlapping light in relation to known modulation frequencies of said more than two diffractive orders by said electronically reconfigurable diffraction grating.

6. The apparatus of claim 2, wherein:

light from said zeroth order comprises content information from said optical storage medium;

light from said first order comprises tracking information from said optical storage medium.

7. The apparatus of claim 2, wherein:

light from said zeroth order comprises content information from said optical storage medium;

light from said first order comprises content information from said optical storage medium;

light from said second order comprises tracking information from said optical storage medium.

8. The apparatus of claim 2, wherein:

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2 light from said zeroth order ~~comprises~~ content
 3 information from said optical storage medium;

4 light from said first order comprises tracking
 5 information from said optical storage medium;

6 light from said second order comprises tracking
 7 information from said optical storage medium.

1 9. The apparatus of claim 3, wherein:

2 light from said zeroth order comprises content
 3 information from said optical storage medium;

4 light from said first order comprises content
 5 information from said optical storage medium;

6 light from said second order comprises tracking
 7 information from said optical storage medium.

1 10. The apparatus of claim 3, wherein:

2 light from said zeroth order comprises content
 3 information from said optical storage medium;

4 light from said first order comprises tracking
 5 information from said optical storage medium;

6 light from said second order comprises tracking
 7 information from said optical storage medium.

1 11. The apparatus of claim 4, wherein:

2 light from said zeroth order comprises information
 3 content from said optical storage medium;

4 light from said first order comprises content
 5 information from said optical storage medium;

6 light from said second order comprises tracking
 7 information from said optical storage medium.

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2 said light striking said photodetector is comprised of;
3 said zero diffractive order with a first set of said
4 measuring properties which comprises a first intensity, a
5 first frequency of intensity modulation, and a first phase;
6 and said first diffractive orders with a second set of said
7 measuring properties which comprises a second intensity, a
8 second frequency of intensity modulation, a second phase;
9 whereby said first orders may overlap with said zero
10 order on said detector;

11 and whereby said zero and first orders may be read
12 simultaneously by said detector and differentiated by said
13 detector by any of their individual said measuring
14 properties.

1 18. The apparatus of claim 2, wherein:

2 said light striking said photodetector is comprised of;
3 said zero diffractive order with a first set of said
4 measuring properties which comprises a first intensity, a
5 first frequency of intensity modulation, and a first phase;
6 said first diffractive orders with a second set of said
7 measuring properties which comprises a second intensity, a
8 second frequency of intensity modulation, a second phase;
9 and said second diffractive orders with a third set of said
10 measuring properties which comprises a third intensity, a
11 third frequency of modulation and a third phase;

12 whereby said first orders may overlap with said zero
13 order on said detector, and said second orders may overlap
14 with said first orders on said detector;

15 and whereby said zero, first and second orders may be
16 read simultaneously by said detector and differentiated by
17 said detector by any of their individual said measuring
18 properties.

1 19. The apparatus of claim 3, wherein:

2 said light striking said photodetector is comprised of;
3 said zero diffractive order with a first set of said
4 measuring properties which comprises a first intensity, a
5 first frequency of intensity modulation, and a first phase;
6 and said first diffractive orders with a second set of said
7 measuring properties which comprises a second intensity, a
8 second frequency of intensity modulation, a second phase;

9 whereby said first orders may overlap with said zero
10 order on said detector;

11 and whereby said zero and first orders may be read
12 simultaneously by said detector and differentiated by said
13 detector by any of their individual said measuring
14 properties.

1 20. The apparatus of claim 3, wherein:

2 said light striking said photodetector is comprised of;
3 said zero diffractive order with a first set of said
4 measuring properties which comprises a first intensity, a
5 first frequency of intensity modulation, and a first phase;
6 said first diffractive orders with a second set of said
7 measuring properties which comprises a second intensity, a
8 second frequency of intensity modulation, a second phase;
9 and said second diffractive orders with a third set of said

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10 measuring properties which comprises a third intensity, a
11 third frequency of modulation and a third phase;

12 whereby said first orders may overlap with said zero
13 order on said detector, and said second orders may overlap
14 with said first orders on said detector;

15 and whereby said zero, first and second orders may be
16 read simultaneously by said detector and differentiated by
17 said detector by any of their individual said measuring
18 properties.

1 21. The apparatus of claim 4, wherein:

2 said light striking said photodetector is comprised of;
3 said zero diffractive order with a first set of said
4 measuring properties which comprises a first intensity, a
5 first frequency of intensity modulation, and a first phase;
6 and said first diffractive orders with a second set of said
7 measuring properties which comprises a second intensity, a
8 second frequency of intensity modulation, a second phase;

9 whereby said first orders may overlap with said zero
10 order on said detector;

11 and whereby said zero and first orders may be read
12 simultaneously by said detector and differentiated by said
13 detector by any of their individual said measuring
14 properties.

1 22. The apparatus of claim 4, wherein:

2 said light striking said photodetector is comprised of;
3 said zero diffractive order with a first set of said
4 measuring properties which comprises a first intensity, a

5 first frequency of intensity modulation, and a first phase;
6 said first diffractive orders with a second set of said
7 measuring properties which comprises a second intensity, a
8 second frequency of intensity modulation, a second phase;
9 and said second diffractive orders with a third set of said
10 measuring properties which comprises a third intensity, a
11 third frequency of modulation and a third phase;

12 whereby said first orders may overlap with said zero
13 order on said detector, and said second orders may overlap
14 with said first orders on said detector;

15 and whereby said zero, first and second orders may be
16 read simultaneously by said detector and differentiated by
17 said detector by any of their individual said measuring
18 properties.

1 23. A method for reading an optical storage device
2 comprising the steps of:

3 modulating relative light intensities of at least two
4 different diffraction orders of light diffracted by an
5 electronically reconfigurable diffraction grating;

6 focusing said light diffracted by said electronically
7 reconfigurable diffraction grating into diffractive spots
8 corresponding with each of said diffraction orders and
9 delivering said directed light onto an optical storage
10 medium, which light is then reflected by said optical
11 storage medium; and

12 detecting said light reflected by said optical storage
13 medium by a detector.

1 24. The method of claim 23, wherein:

2 said diffraction orders comprise two diffraction orders
3 comprising zeroth and first diffraction orders;

4 said diffractive spots corresponding with said zeroth
5 order partially overlaps with said diffractive spots
6 corresponding with said first order; and further comprising,

7 resolving overlapping light from said zeroth and first
8 diffractive orders by said detector into its proper orders

9 by examining the modulation of the intensities of said

10 overlapping light in relation to known modulation

11 frequencies of said zeroth and first diffraction orders by

12 said electronically reconfigurable diffraction grating.

1 25. The method of claim 23, wherein:

2 said diffraction orders comprise more than two
3 diffraction orders, comprising zeroth and first diffraction
4 orders, and at least one additional diffraction order higher
5 than said zeroth and first diffraction orders.

1 26. The method of claim 23, wherein:

2 said diffraction orders comprise more than two
3 diffraction orders, comprising zeroth and first diffraction
4 orders, and at least one additional diffraction order higher
5 than said zeroth and first diffraction orders;

6 said diffractive spots corresponding with each said
7 diffraction order partially overlap with said diffractive
8 spots corresponding with at least a diffraction order
9 adjacent thereto; and further comprising

10 resolving overlapping light from said more than two
11 diffractive orders by said detector into its proper orders
12 by examining the modulation of intensities of said
13 overlapping light in relation to known modulation
14 frequencies of said more than two diffractive orders by said
15 electronically reconfigurable diffraction grating.

1 27. The method of claim 23, wherein:

2 said diffraction orders comprise more than two
3 diffraction orders, comprising zeroth and first diffraction
4 orders, and at least one additional diffraction order higher
5 than said zeroth and first diffraction orders;

6 said delivery and focusing optics causes said
7 diffractive spots corresponding with each said diffraction
8 order to partially overlap with said diffractive spots
9 corresponding with at least a diffraction order adjacent
10 thereto; and further comprising,

11 resolving overlapping light from said more than two
12 diffractive orders by said detector into its proper orders
13 by examining the modulation of intensities and the phase
14 shift of said overlapping light in relation to known
15 modulation frequencies of said more than two diffractive
16 orders by said electronically reconfigurable diffraction
17 grating.

1 28. The method of claim 24,

2 said light from said zeroth order comprising content
3 information from said optical storage medium;

4 said light from said first order comprising tracking
5 information from said optical storage medium.

1 29. The method of claim 24,

2 said light from said zeroth order comprising content
3 information from said optical storage medium;

4 said light from said first order comprising content
5 information from said optical storage medium

6 said light from said second order comprising tracking
7 information from said optical storage medium.

1 30. The method of claim 24,

2 said light from said zeroth order comprising content
3 information from said optical storage medium;

4 said light from said first order comprising tracking
5 information from said optical storage medium.

6 said light from said second order comprising tracking
7 information from said optical storage medium.

1 31. The method of claim 25,

2 said light from said zeroth order comprising content
3 information from said optical storage medium;

4 said light from said first order comprising content
5 information from said optical storage medium

6 said light from said second order comprising tracking
7 information from said optical storage medium.

1 32. The method of claim 25,

2 said light from said zeroth order comprising content
3 information from said optical storage medium;

4 said light from said first order comprising tracking
5 information from said optical storage medium;

6 said light from said second order comprising tracking
7 information from said optical storage medium.

1 33. The method of claim 26,

2 said light from said zeroth order comprising
3 information content from said optical storage medium;

4 said light from said first order comprising content
5 information from said optical storage medium;

6 said light from said second order comprising tracking
7 information from said optical storage medium.

1 34. The method of claim 26,

2 said light from said zeroth order comprising content
3 information from said optical storage medium;

4 said light from said first order comprising tracking
5 information from said optical storage medium;

6 said light from said second order comprising tracking
7 information from said optical storage medium.

1 35. The method of claim 23,

2 said electronically reconfigurable diffraction grating
3 comprising a reflection grating.

1 36. The method of claim 23,

2 said electronically reconfigurable diffraction grating
3 comprising a transmission grating.

1 37. The method of claim 23,

2 said apparatus reads content and tracking information
3 prerecorded on said optical storage medium.

1 38. The method of claim 23,
2 striking said photodetector with said light further
3 comprising at least two individual said diffractive orders;
4 whereby each individual said diffractive order has
5 measuring properties comprising said intensity, said
6 frequency of intensity modulation, and said phase; and
7 measuring by said photodetector of said individual
8 diffractive orders by utilizing at least one of said
9 measuring property.

1 39. The method of claim 24,
2 striking said photodetector with said light further
3 comprising;
4 said zero diffractive order with a first set of said
5 measuring properties comprising a first intensity, a first
6 frequency of intensity modulation, and a first phase; and
7 said first diffractive orders with a second set of said
8 measuring properties comprising a second intensity, a second
9 frequency of intensity modulation, a second phase;
10 overlapping of said first orders with said zero order
11 on said detector;
12 reading simultaneously by said detector said zero and
13 said first diffractive orders and differentiating by said
14 detector utilizing any of their individual said measuring
15 properties.

1 40. The method of claim 24,
2 striking said photodetector with said light further
3 comprising;

4 said zero diffractive order with a first set of said
5 measuring properties comprising a first intensity, a first
6 frequency of intensity modulation, and a first phase; and
7 said first diffractive orders with a second set of said
8 measuring properties comprising a second intensity, a second
9 frequency of intensity modulation, a second phase; and
10 said second diffractive orders with a third set of said
11 measuring properties comprising a third intensity, a third
12 frequency of modulation and a third phase;
13 overlapping of said first orders with said zero order
14 on said detector, and overlapping of said second orders on
15 said detector;
16 reading simultaneously by said detector said zero
17 diffractive order, said first diffractive orders and said
18 second diffractive orders, differentiating by said detector
19 utilizing any of their individual said measuring properties.

1 41. The method of claim 25,

2 striking said photodetector with said light further
3 comprising;

4 said zero diffractive order with a first set of said
5 measuring properties comprising a first intensity, a first
6 frequency of intensity modulation, and a first phase; and
7 said first diffractive orders with a second set of said
8 measuring properties comprising a second intensity, a second
9 frequency of intensity modulation, a second phase;

10 overlapping of said first orders with said zero order
11 on said detector;

12 reading simultaneously by said detector said zero and
13 said first diffractive orders and differentiating by said
14 detector utilizing any of their individual said measuring
15 properties.

1 42. The method of claim 25,

2 striking said photodetector with said light further
3 comprising;

4 said zero diffractive order with a first set of said
5 measuring properties comprising a first intensity, a first
6 frequency of intensity modulation, and a first phase; and

7 said first diffractive orders with a second set of said
8 measuring properties comprising a second intensity, a second
9 frequency of intensity modulation, a second phase; and

10 said second diffractive orders with a third set of said
11 measuring properties comprising a third intensity, a third
12 frequency of modulation and a third phase;

13 overlapping of said first orders with said zero order
14 on said detector, and overlapping of said second orders on
15 said detector;

16 reading simultaneously by said detector said zero
17 diffractive order, said first diffractive orders and said
18 second diffractive orders, differentiating by said detector
19 utilizing any of their individual said measuring properties.

1 43. The method of claim 26,

2 striking said photodetector with said light further
3 comprising;

4 said zero diffractive order with a first set of said
5 measuring properties comprising a first intensity, a first
6 frequency of intensity modulation, and a first phase; and
7 said first diffractive orders with a second set of said
8 measuring properties comprising a second intensity, a second
9 frequency of intensity modulation, a second phase;
10 overlapping of said first orders with said zero order
11 on said detector;
12 reading simultaneously by said detector said zero and
13 said first diffractive orders and differentiating by said
14 detector utilizing any of their individual said measuring
15 properties.

1 44. The method of claim 26,

2 striking said photodetector with said light further
3 comprising;

4 said zero diffractive order with a first set of said
5 measuring properties comprising a first intensity, a first
6 frequency of intensity modulation, and a first phase; and

7 said first diffractive orders with a second set of said
8 measuring properties comprising a second intensity, a second
9 frequency of intensity modulation, a second phase; and

10 said second diffractive orders with a third set of said
11 measuring properties comprising a third intensity, a third
12 frequency of modulation and a third phase;

13 overlapping of said first orders with said zero order
14 on said detector, and overlapping of said second orders on
15 said detector;

16 reading simultaneously by said detector said zero
17 diffractive order, said first diffractive orders and said
18 second diffractive orders, differentiating by said detector
19 utilizing any of their individual said measuring properties.

1 45. A method for detecting and interpreting light signals
2 striking a detector of an optical pickup apparatus,
3 comprising the steps of:

4 causing said light signal to strike said detector in a
5 manner that comprises at least two individual diffractive
6 orders, whereby each said individual diffractive order is
7 possessing individual measuring properties comprising an
8 intensity, an intensity modulation and a phase;
9 interpreting said light signal striking said detector
10 by reading said individual measuring properties of each said
11 individual diffractive order and extracting content or
12 tracking information.

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